



Entrepreneurship and inequality in Latin America: social entrepreneurship for the generation of networking and absorptive capabilities

*Ivan Hernandez*¹

1. Introduction

This paper intends to contribute to the current debate about the need of social and productive technological change in LDCs. In particular, we analyse micro-enterprises and SMEs' role in the tecno-economic paradigm change. Although commonly associated to either traditional and retardant forces, the point we wish to make is that the vast majority of the latent and emergent entrepreneurial force (i.e. micro-enterprises and SMEs) in LDCs, at present largely disconnected from the national and transnational economic circuit, represent a huge potential for the techno-economic paradigm change. By analogy, these latent forces represent what Albert Einstein taught us about whereby a single brick can be made to release a huge amount of energy in the form of an atomic explosion (De Soto 2000). Latent entrepreneurship is comparable to the potential nuclear energy in Einstein's brick, however, as should be clear by the end of the paper, our examination departs from that of the De Soto's in some important aspects.

¹ PhD (U. of Manchester, CRIC) - Associate Professor, School of Economics and Director of the Research Group on Evolutionary and Institutional Economics, National University of Colombia, part of the Centre for Interdisciplinary Studies in Basic and Applied Complexity (CEIBA)- Emails: idhernandezu@unal.edu.co, idhu1970@hotmail.com, *Tel: 00-571-316-53 61

Traditionally, the common association between microenterprises/SMEs and national/transnational globalised firms is basically one of exploitative labour or maquila-type of contractual relations, in some cases. In other cases, this relation is studied under the NGO's/social responsibility point of view, and, in other cases, they are limited to a competitive relation under unfair or illegal frameworks within the formal/informal duality. Under our study the association is between social entrepreneurship and cooperative networking relations under the presumption that microenterprises/SMEs have an economic knowledge-related advantage to offer to the globalised and interconnected economic system. These interconnections are based on an underlying strategy that seems could work well both ways. Microenterprises and SMEs cannot be just underestimated or ignored as something that will be absorbed or replaced but can rather be interconnected with the globalised economic circuit through the concept of *social entrepreneurship for the generation of networking capabilities*.

That is why we appeal to another typology of firms and to Granovetter's "embeddedness" argument, in which interconnections are central. Latin America, together with Africa and Middle East, according to The Global Entrepreneurship Monitor (GEM hereafter), count with the highest number of *necessity-based entrepreneurship*² in the world. In effect, whilst in the developed world, in average, one (1) entrepreneur out of ten (10) is based in necessity, in Latin America this same kind of entrepreneurship is 4 times greater (!), that is, for every 10 entrepreneurs in Latin America, approximately, 4 come out of necessity.

² Firms that were founded by unemployed individuals who chose to become self-employed by starting a new firm.

Hence, the “Latin American way” of entrepreneurship, by its own nature, has different connotations from the rest of the world. Unfortunately, the implicit target “back in the head” of policy makers and researchers is still *opportunity-based entrepreneurship*³.

The general idea that emerges from this research is the need in the Latin American economic system to reduce the inequity and disconnection between *necessity-based entrepreneurship* and *opportunity-based entrepreneurship* through the social entrepreneurship for generation of networking capabilities. There is a need for institutional change based not only on commercial and labour contracts (e.g. formalization and tax incentives differentiated between companies), but also in generating organizational capabilities to build dense networks of cohesion, trust, inclusiveness and integration of necessity-based firms that are marginalized from the economic system circuit of the opportunity-based firms. A similar set of ideas were pointed out by Arthur Lewis and, in Colombia, by Professor Lauchlin Currie (Lewis 1954 and 1955, Currie 1974, 1981 and 1997). Their ideas were related to the integration of undervalued, low-skilled labour into productive activities with backward and forward linkages, or so-called “leading sectors” (such as construction and exports). The foci in this paper are inter-firms’ relations, rather than simply the absorption of large masses of low-skilled rural immigrants.

³ Firms that were founded based on the perception of a business opportunity. The distinction between “opportunity-based” and “necessity-based” entrepreneurial activity has been given highlighted by surveys conducted by the Global Entrepreneurship Monitor (GEM) as a way to distinguish between countries where new firm creation occurs mostly due to opportunity recognition from those where new firm creation occurs mostly to escape unemployment. If unemployment is the main incentive for setting up a business, there may not be time to look for good opportunities, make detailed plans, and seek advice. Thus, independent from productivity and/or learning effects that occur after start-up, chances of survival may be affected by selection effects occurring prior to start-up.

This paper develops a model based on the network theory (Granovetter 1973, 1985, Powell and Grodal 2005), the problem of exploitation and exploration of knowledge (Nooteboom 2002) and the work of Deutsh (1973), and Lazaric and Raybaut (2005). It studies the role that necessity- and opportunity-based firms have in a developing society that intends to ascend in the technological ladder towards greater added value and complex activities by determining the role of each type of firms in organizations' knowledge generation processes.

The model has the following stylized organizational structures. The first organizational structure is the necessity-based firm: we assume that networks in this case are of the parochial type (Bowles and Gintis 2004), in which there are relations within family, ethnic groups, or cliques that achieve high levels of cooperation whilst excluding other type of groups. This firm is characterized for having an entrepreneur that creates a firm in order to escape unemployment; he or she contacts close individuals (family and/or friends), generating an organizational structure with strong ties. The second stylized organizational structure is the opportunity-based firm: this type of organization is created after an individual ends a relation with an existent firm (as worker, provider, client, etc.). The entrepreneur teams up with individuals through weak ties, embedded in communities conformed by experts, assessors, consultants, or learning, innovation or socialization networks (Stephenson 2000).

The opportunity-based firms are closely related to the Schumpeterian type of entrepreneurship which explores new knowledge —known also as equilibrium-disturbing entrepreneur—, whilst the necessity-based firms are closely related to the Kirznerian type of entrepreneurship which exploits new uses of knowledge —known also as equilibrium-creating entrepreneur— (Gebel, Pyka and Hanusch 2004). These two types of entrepreneurship maintain the system out-of-equilibrium as centripetal and centrifugal forces, strengthening the capacity of absorption (accumulation+assimilation) of technology and knowledge in a developing country (Nelson and Pack 1999).

The model explains the dynamics by which both types of firms have some needs that are complemented by each other. This generates a creative encounter through inter-firms' cooperation networks for learning and the diffusion of information and knowledge. The necessity-based firms (familiar/tradicional/parochial), with a strong impact over national employment in LDCs but, at the same time, in low productivity and innovation activities. On the other hand, opportunity-based firms embedded in complex business networks and greater value-added and innovative activities, but without major employment generation.

Cooperation, competition and indifference

Deutsch (1973) assumes that the individuals and groups work to satisfy their own interests, striving to reach their goals. However, the search of their particular and selfish interests need not necessarily contradict the unfolding of collaboration and teamworking. Deutsch emphasized on goal's perception determines how agents interact and the models of the interaction, in turn, determine the results.

The goals can be cooperative, competitive or independently related (chart 1). If agents consider that their goals are correlated positively (i.e. if others reach or at least come closer toward their goals, then we also come closer to our own goals), cooperative behaviour ensues. If agents perceive that their goals are correlated negatively with the goals of others (i.e. we perceive that if the others reach their goals then it makes less probable our own goal achievement) , competitive behaviour ensues. On other side, if agents perceive that the achievement of other agent's goals are independent of ours, then indifference behaviour ensues.

Table 1 - Cooperation, competition and indifference

	<i>Expectations about others</i>		
	<i>With goals correlated:</i>		<i>With independent goals</i>
	<i>Positively</i>	<i>Negatively</i>	
We	<i>We can wait the others will cooperate</i>	<i>We can wait the others will compete</i>	<i>We can wait the others will be indifferent</i>

Based in Deutch (1973) and Wong and Yu (2004).

If members of a team understand that their goals are critically cooperative or they are, on the contrary, competitive or independent talvez between each other, this affects their expectations, interactions and results. People with cooperative goals - ie. the achievement of other others helps our goal - they take actions so that others do well. Under these

circumstances it is expected that all use their abilities to work in mutual benefit. However, under competition - ie. some work for their own goals at the expense of the achievements of others - people conceal or withhold information and ideas as they protect their own goals; they can even be tempted to obstruct the progress of others or take advantage of their co-workers (i.e. role of opportunism). In this way, people want "to win" the competition and so they need others to "lose". With independent goals, people hope the individuals of a group work for their own goals with small or no regard for the goals of others. As there are few incentives to use their abilities in benefit of others, they abstain of interacting and show indifference in the face of the progress of others.

Cyclical behavior between cooperation, competition and indifference

Accordingly, the behavior of agents varies along three roles depending on the perception of the goals, which influence in actions and production. We will model in the following sections the variation of the working hours agent engaged in each role in an instant of time t . When an agent assumes the competition role, she tends to take advantage of the co-workers in search of new information and she concentrates on her own interests at the detriment of others' interests. But when an agent assumes the role of collaboration, she frequently interacts with, shares information and learns from co-workers. The agent that assumes the role of indifference expects others to work focused on their own goals with little or any consideration for her own goal.

A person can assume all the roles but in different instants of time. A worker can assume in this way in the course of only one day the roles of collaboration, indifference and competition. For this reason we use terms as collaboration/indifference/competition "roles" and not collaborative/indifferent/competitive as "agents", and units of measure being working hours and not in number of agents.

The variation of the competition, indifference and collaboration roles is based on the cycle of the firm. The following section shows the recurrent behavior in which a high competition level precedes a high cooperation level and vice versa. Within these periods exists one period of both high competition and high cooperation. When there are low levels in the role of both competition and collaboration, it is because there are high levels of indifference or independence of goals among the members of the firm.

Cycle of the firm

a. Foundation

During the foundation of a firm that seeks to supply a recently discovered and unsatisfied necessity of the consumers, begins to interweave the interrelations in the individuals' goals inside an organization. However, at the beginning, it is not clearly defined how agents are correlated to each other (Figure 1). That is to say, an essential problem is presented inside the organization: according to Wong and Yu (2004), it has not been generated a shared vision nor cooperative goals. The implicit risk and uncertainty is that the competition settles down a new trajectory in the organization: it doesn't stop of being

a latent threat - but not unavoidable - inside the organizations. The teams have reasons to believe that they can be exploited by other co-workers, who openly work for their own interests and not for the collective benefit. The competition is not simply a necessary consequence of having selfish co-workers but, in effect, it is a possible trajectory of the firm. Depending on the perceptions of goal correlation the members of an organization recognize that the interests are cooperatively related and the organization can enter in a trajectory of minimum competition and, generally, teams are able to prepare better to work efficiently.

b. Phase of exploitation: low competition and high cooperation (you put correlated positively)

The challenge that a firm faces in this period is to induce agents to work as a team in favor of the entrepreneur's idea, which just begins to be communicated and understood among its members. The leader's innate abilities (i.e. eloquence, persuasion, patience and persistence, sympathy and trust, etc.) are crucial in this point through the informal communication. The attainment of goals and the cognitive processes that operate to communicate the particularities and the restrictions of the business idea, generate levels of regularity among the whole existent subjective variation in the business conception. The coordination costs are highly specific and "sunken" (to See Figure 1).

Witt (1999) indicates that the exercise of leadership bears some inherent risks, because it depends on the quality and interest that the conception of the business idea wakes up

among the members of the organization. The success or failure of this conception depends on its quality and in the way it affects the material conditions of the employees (remuneration, benefits, opportunities, career options, working conditions). If this causes satisfaction (or disutility) among the employees, the manager's leadership can consolidate (or turn out to be affected negatively).

Also, Witt (1999) emphasizes that the communication, particularly the non formal available through the socialization networks inside the firm, allows the agents to observe and to compare the behavior of other agents. If there is more frequent and more intense observations of other people, then the better the internal representations of subjective knowledge - 'tacit' – are, so that they can be understood and acquired through imitation. In fact, the socialization with others and the unconscious imitation of certain behavior features spreads to induce cognitive regularities among the individuals and to generate expectations of collective behavior. In this way, team working develops a common direction, identity, values, integrated roles, common tasks, personal interrelations, and the distributions of shared prizes that reinforce the interdependence of the combined cooperative goal.

c. Phase of exploitation and exploration: high competition and high cooperation (positively and negatively correlated goals)

The constant necessity that organizations face to "import" new knowledge is a threat to the teamwork and the sunken and specific coordination costs of the firm. First, the personnel's rotation that entails the selection of ideas inside a firm or, second, the new

recruiting to generate a capacity of absorption of new technologies and the learning of new information (to see section 7.1.1 of the chapter one), both represent external threats to the regularities in the firm that new intra-organizational challenges impose. The high competition among groups of the firm and the high cooperation to diffuse their own ideas within these groups, are a characteristic at this stage.

The organizations face two types of problems in this following phase:

- 1) Hire employees to explore new knowledge or
- 2) Create within the firm the knowledge that is required so they do not have to take a risk some cohesion and idiosyncratic elements that characterize the organizational culture of the firm (Simón 1991, p. 128).

d. Exploration Phase: high competition and low cooperation (negatively correlated goals)

The growing necessity of specialized knowledge entails a high competition of ideas and, hence, the displacement of old ideas for new ones. A conflict is generated between those who represent the status quo and those who represent the necessity of change. The diffusion of new ideas requires new recruitings and, in turn, implies the displacement of other ideas so that new knowledge is explored or is generated within the firm. This implies a rotation of personnel due to the entrance and exit of agents within the firm. When hiring new agents to replace the salient ones, a period of decrease in cooperation due to the destruction of old routines and an increment of perceptions of non-correlated goals or a higher cognitive distance with the new members of the firm (see figure 1).

e. Re-starting the cycle

A new phase of low cooperation and low competition occurs when a "creative destruction" replaces old ideas for new ones. There is no clear perception of goals' interdependence or among agent's roles. The cycle of convergences and divergences engenders a new cycle of a reconverted and modernized firm.

Limits and scope of the model

This firm cycle may not present itself exactly in the deterministic order described here, but the model intends to pick up the variety and implicit dynamics of the teamwork and coordination and subsequent reconstruction due to the need of cohesion and "importation" of new ideas (Simon 1991). The pattern of Lotka and Volterra adapted to pick up this cycle by means of a predator-prey model shows the levels of collaboration (prey) and of opportunism (predators) inside the cycle described previously.

Model

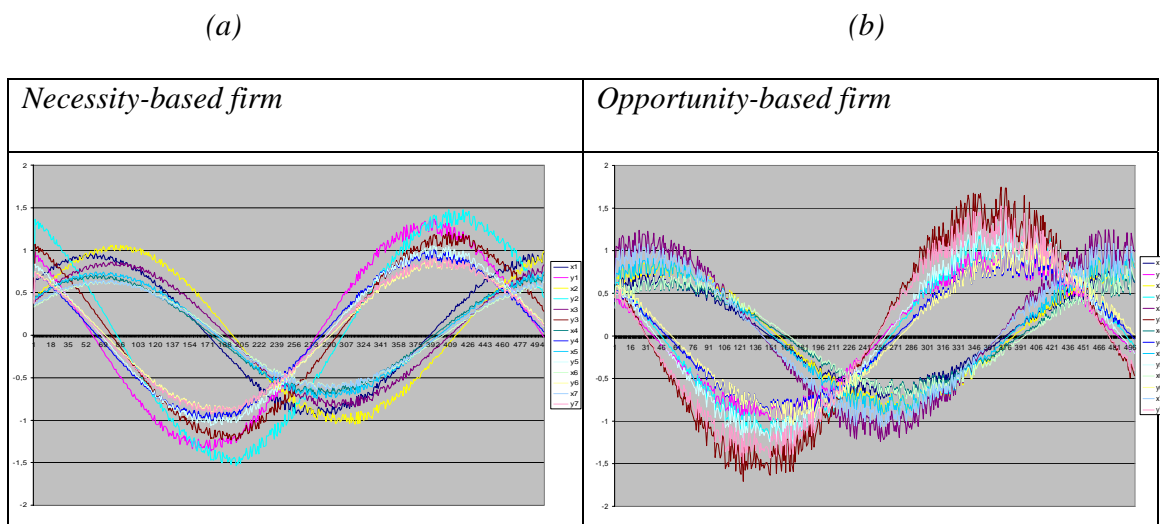
See mathematical appendix for the model specification.

Simulations

Results of simulations denote three differences between the two organizational structures.

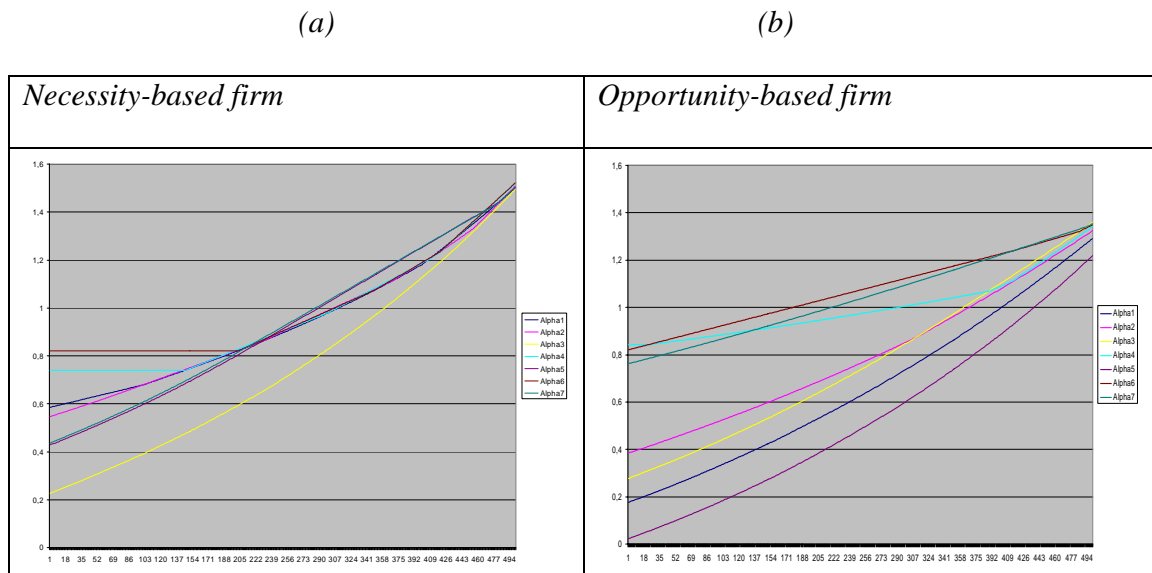
First, there is a greater control in the dynamics of the competition/collaboration cycle within the organizational structure of the necessity-based firm (see Figure 2 (a)), since the oscillations are much more stable than in the case of the opportunity-based firm (see Figure 2 (b)). What characterized the necessity-based firms are the centralized channels of diffusion of information through an entrepreneurial leader which takes care of volatility of competition/collaboration cycle based on strong ties and networking.

Figure 2 - Variance of the competition/collaboration cycle



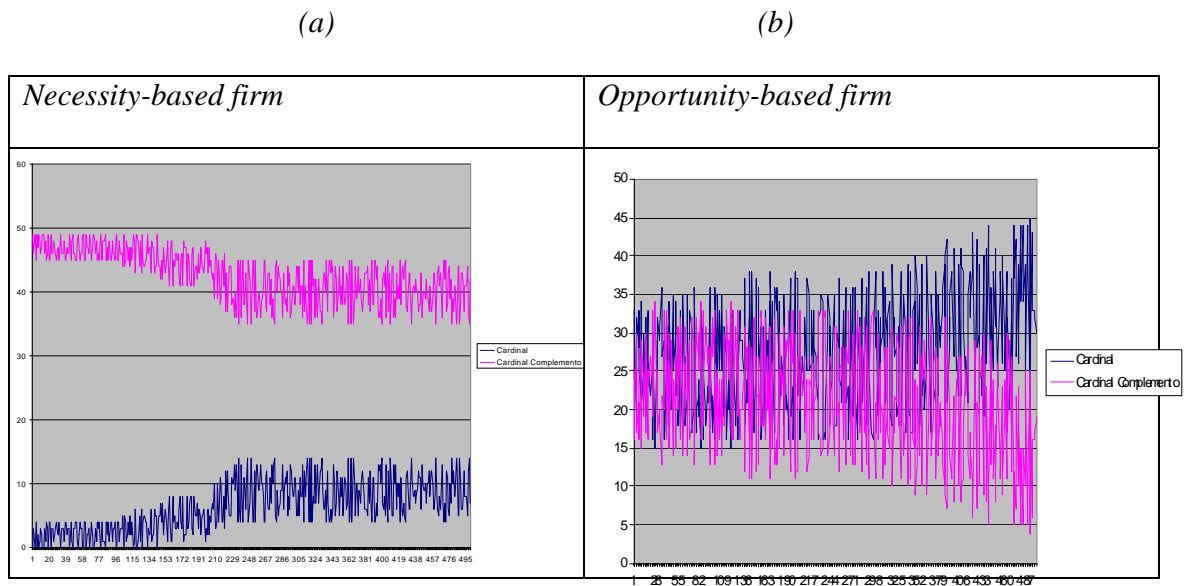
Second, the speed to which the communication among agents is carried out in order to adopt other's practices depends strongly on the organizational structure of the company. In this way, the diffusion of best practices information spreads more rapidly within the opportunity-based firm (see Figure 3 (b)) than in the necessity-based firm (see Figure 3 (a)).

Figure 3 - Adoption of Practices



As last remark, the adoption of new information and knowledge in the firm is carried out more efficiently under the organizational structure of the opportunity-based firm (see Figure 4 (b)). The most relevant innovations are incorporated by the agents of this type of firm and it does not stay in the periphery, like happens in the necessity-based firm (Figure 4 (a)).

Figure 4 – Incorporation of new knowledge.



Analysis

Necessity-based firms have a significant weight in an economy in developing countries (GEM 2007). These firms count with strong ties (Powell and Grodal 2005) through which an effective social control and learning of tacit knowledge can be exercised (see Figure 2). That is to say, they play the important role of cohesion by means of strong ties among the members of the firms: their practices tend to converge toward one objective so that regularities can be generated in the expectations of the others' behavior. However, the new data and the new information in this type of firm do not incorporate easily or quickly to the practices of the individuals in the firm. This entails that innovative activities cannot be absorbed easily; this structure places, hence, new knowledge in the periphery for a long time (Figure 4). Under this context, this type of firms associates more with the

Kirznerian-type of entrepreneur, which is based on the second order learning (i.e. new use of existent knowledge), based on people interacting regularly and, therefore, having a low cognitive distance. However, when the cognitive distance is low, interactions with new people are few, and then the biggest advantage is taken from existent people. That is to say, under this structure, *we obtain more, but of the same things*.

On the other side, opportunity-based firm do not have as significant weight in developing countries as in developed countries. They are characterized to have communities in the form of networks and weak ties by means of which new data and new knowledge incorporates quicker in the practices of the firms' agents. This structure is easily induced in innovative activities (Figure 4). In this way, its structure admits the access again to knowledge and its strength are more productive and innovative activities. However, this same structure can generate filtration of information due to its weak ties and, hence, weakens the cohesion among the members in order to standardize best practices.

The following Table 2 summarizes the former analysis.

Table 2 – Schumpeterian (oportunidad-based) and Kirznerian (necessity-based) entrepreneurs

Entrepreneurship	Relative disadvantage:	Relative advantage:
<i>Schumpeterian (oportunidad-based)</i>	Information leakage or filtration	Exploration: first order learning processes (in the

<i>entrepreneurs</i>	Cohesion weakening	sense of Nooteboom 2000) “Weak” ties and Networks (in the sense of Powell and Grodal 2005) New ideas are more adequately incorporated as well as a greater absorption capability
<i>Kirznerian (necessity-based) entrepreneurs</i>	New ideas and innovations are not easily incorporated	“Strong” links and networks (in the sense of Powell and Grodal 2005) Strong social control social of opportunism and collaboration Exploitation: second order learning (in the sense of Nooteboom 2000) Cohesion

Conclusions

An especially useful conclusion for firms in the developing countries context in emergent economies are based in the simulations results. These suggest that each type of firm, like those based on necessity and on opportunity, have an important role or function to play in the techno-economic change. The relative advantage of the opportunity-based companies

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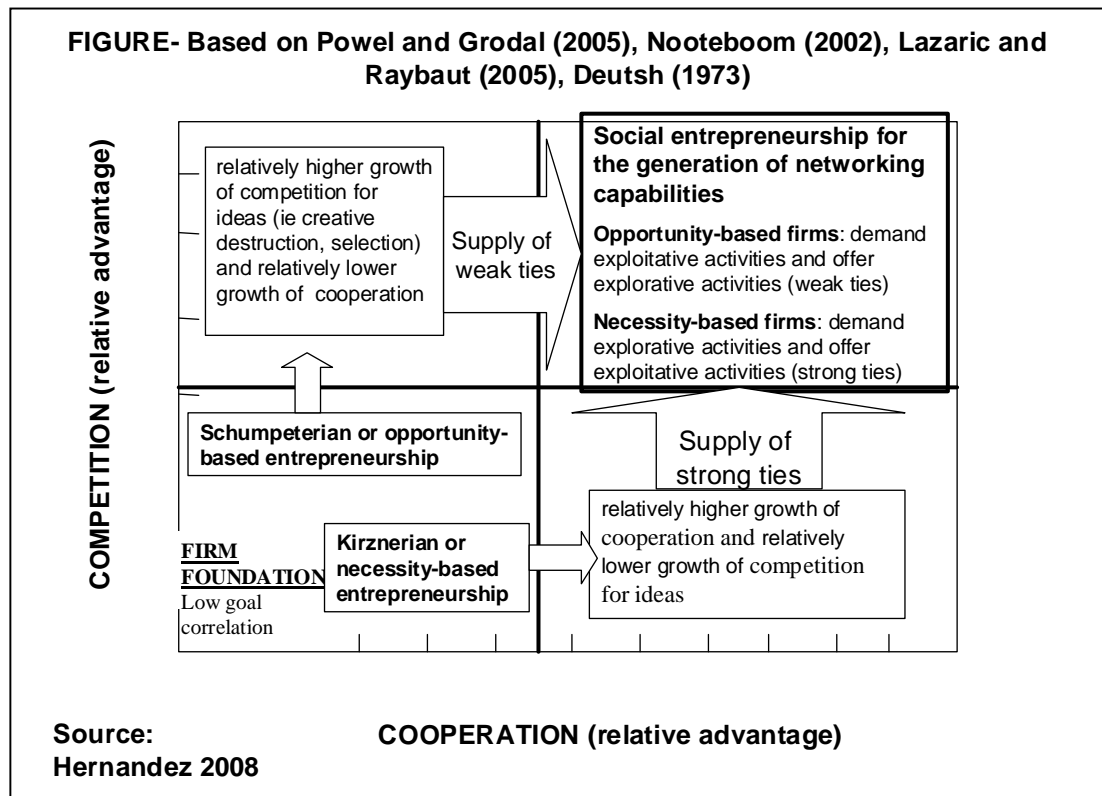
is the reduction of "cognitive myopia" or higher absorption of new-incoming information, for example, of foreign technology and therefore for the "import" of the innovations, which makes it a key institution for the stage of "accumulation" phase of the technoeconomic paradigm (in terms of Perez (2002) is the irruption and frenzy phases). While the necessity-based firms are more effective in exercising the basic function of the intra-organizational learning of tacit knowledge and the control of opportunistic behavior and the promotion of cooperation, which transforms it into a key institution for the "assimilation" phase of technologies (Nelson and Pack 1999). There is no, hence, "optimal" organizational structure, but rather each structure has relative advantages, depending on the context and the time.

But there is no diffused new knowledge until there is a real distributed system of knowledge among the minds of producers and consumers of a society that have really been impacted by this new technologies in a technological diffusion process. This includes not only the accumulative aspect but also the technological assimilation (Nelson and Pack 1999, Nelson and Sampat 2000) of mass produced goods and services to the "Bases of Economic Pyramid" especially by means of the inherent advantage of the necessity-based firms (Prahalad 2005). The ignorance of the relative advantages and the existent disconnection between the opportunity-based and necessity-based is a decisive factor in this investigation.

These two types of entrepreneurship complement each other in strengthening the capacity of absorption (accumulation+assimilation) of technology and knowledge in a developing

country. These results are strongly related to the co-evolution between accumulation and assimilation of technology in terms of Nelson and Pack (1999), and also other authors like Perez (2002) and Lundvall (2003). The models explain the dynamics by which both type of organization structures have demands and supplies that complement each other to generate a creative encounter by means of inter-firms' collaboration networking for learning and diffusion of knowledge in an economy. The necessity-based firms (familiar/parochial), have a strong impact over the impact of the employment of a developing country and, at the same time, are located in low productivity and innovation activities. On the other hand, opportunity-based firms (embedded in complex business and high-technology networking) are located in activities with higher added-value and innovation, but that are not generating a big impact on employment.

The following Figure presents the dynamics or interface between necessity and opportunity-based firms, addressed in this research.



Both classes of firms have an important role in the change and advancement in the techno-paradigm. Moreover, the paradox is that opportunity-based companies, as suggested by the evidence and the results of the research, rely on the relative advantage of necessity-based companies to generate agreements and understandings on the economic and social needs in a society. However, despite this co-dependence between opportunity and necessity-based firms in developing countries, the “survival” firms are often under the law and in economic terms, in a situation of vulnerability and instability compared to opportunity-based firms. It is in cases like this that the inter-firms’ relations should be transformed to a new kind of relations based on cooperation. Connectivity in inter-firms’ relations, based on cooperation, not only apply to charitable institutions

(which are not discarded), but also on other type of institutions that allow learning, organization, absorption, adaptation and innovation and knowledge generation in the context of business opportunities and profits for all parties, in response to economic and social needs. The results presented in this research involve therefore a process of collective learning and innovation capabilities.

A similar set of ideas were pointed out, and even materialized through economic policies implemented decades ago, by development theorists such as Arthur Lewis, Nobel laureate in economics, and in Colombia, by Professor Lauchlin Currie in the early 70s (Lewis 1954 and 1955, Currie 1974, 1981 and 1997). Their ideas were related to the integration of underutilized, unemployed (or at least disguisedly unemployed), low-skilled labour (including agriculture) into productive activities and sectors with backward and forward linkages of value-added chains (especially with forward linkages), or so-called leading sectors (such as construction and exports). The locus presented in this paper are the relationships inter-firms in a world of technological information flows, rather than simply based on the work and contractual relations for the absorption of large masses of low-skilled rural immigrants. Of course, it must be emphasized that there is an inherent risk which is to reproduce the same subordinate relations that workers have intra-firm into inter-firms' relations, rather than the collaborating and cohesive networks we are looking for between firms. However, the access to the great mass of consumers of scarce resources that necessity-based and informal entrepreneurs have access could be a deterrent for big businesses to exploit them.

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This strategy of economic development, paraphrasing Hirschman, concentrates surplus on integrating forces in the economic system to link, enhance and channel existing social relations, recombining and reconfiguring them in the economic system. This is a social innovation, which requires social entrepreneurs, that are called to generate this type of networking capabilities. The problem now relies on the *equality* in the “barter terms” of exchange between these types of firms. Future research on social entrepreneurship based on cases such as Grammen Bank, Juan Valdez, E+Co, Parquesoft and the alliance between big food suppliers and neighborhood small stores (Guarin 2007, Hernandez 2008), among many other cases, might introduce us to wide range of examples and how just (or unjust for the matter) social entrepreneurship can be done. Forthcoming research should present to us some first cases that exemplify the main results of the model presented here.

MATHEMATICAL APPENDIX

The model of Lotka and Volterra

The following model of duality between firms analyzes the paper of the networking mechanisms intra-firm and the conflict between opportunism (i.e. competition) and cooperation based mainly in Deutch (1973), Lazaric and Rayboud (2005) and Nooteboom (2000). The objective of this work is to study the intraorganizational learning by means of contacts in a network, the generation of knowledge and diversity of performance between firms and its implications.

The individuals that engage in the competitive or opportunism role tend to take advantage of the co-workers in search of knowledge and they follow their own interests given negatively correlated goals; while the agents engaged in the role of collaboration interact frequently, share information and learn of their co-workers.

When analyzing in the previous section the dynamics of the previous role, we find a similarity exists between opportunism' (highly competitive) roles and collaboration with the predator-prey pattern of Lotka and Volterra. For our case, the individuals engaged in the competitive or opportunistic role have a relationship with the behavior of the "predators" and the individuals engaged in the collaborative role are associated with "preys". However, opportunism-collaboration's dynamics present some differences regarding that of Lotka and Volterra.

About the assumptions of the dynamics, the following equations model those dynamics.

In the dynamics of the collaborative and opportunistic roles in the instant t , we suppose that:

- In absence of opportunism, the dynamics of collaboration increases proportionally to the current working hours of agents engaged in opportunism; that is to say that, $\frac{dx}{dt} = A_x x$ when $y = 0$. (A_x is the rate of the collaboration growth in the instant t).

- In absence of collaboration, the dynamics of opportunism increases proportionally to the current working hours of agents engaged in opportunism; $\frac{dy}{dt} = A_y y$, when $x = 0$. (A_y is the rate of the opportunism growth.).
- The growth rates do not make reference to A_x and A_y having positive sign, given that it is possible these rates having negative sign.
- The form how the collaboration and opportunism interact will depend on the probability that opportunism has of obtaining information, the probability that that an agent engaged in collaboration allows in time t an agent engaged in opportunism obtain information and the respective current working hours of agents engaged in opportunism. In this way, the growth ratio of opportunism is $A_{yx}x$ and growth ratio of collaboration is $A_{xy}y$. Where A_{xy} and A_{yx} they are the probabilities that an agent engaged in opportunism obtains information of an agent engaged in collaboration and that he or she allows the former to obtain information at his or her detriment, respectively.
- Both working hours of agents engaged in each role are homogeneous, that is, factors like the age or the gender are not accounted for.
- The encounters between agents engaged in collaboration and opportunism are equally probable.

Based on the previous assumptions, the growth equations of the roles' dynamics are:

$$\frac{dx}{dt} = A_x x - A_{xy} y \quad (1)$$

$$\frac{dy}{dt} = A_y y - A_{yx} x \quad (2)$$

To analyze the terms of each equation we are based in the Lazaric's and Raybout's (2005) model. The expression (1) indicates that the dynamics of the collaboration role varies in an instant t and is given by the difference between the product of the rate of collaboration' growth and the current working hours of agents engaged in collaboration and, the product between the probability that the agent engaged in opportunism obtains information from the agent engaged in collaboration and the current working hours of agents engaged in opportunism.

Lets observe the following example: suppose that the current working hours of agents engaged in collaboration is x and that of opportunism is y ; if the probability that an agent engaged in opportunism obtains information is high, this probability tends to 1, then by multiplying it by the population of opportunism the product is almost y , hence it makes sense to subtract the rate of collaboration' growth times the population of collaboration.

Similarly the equation (2) indicates that the variation of opportunism in an instant t is given by the difference between the product of the rate of opportunism' growth and the

current population and, the product between the probability that the collaboration allows the opportunism to obtain information times the current working hours of agents engaged in collaboration.

To understand the equation (1) we define the neighborhood of individuals that share information in firm like Γ_{x_t} and we consider Ω_t as the matrix of contacts in an instant t.

Contacts are represented by l_{ij} which is an element that belongs to the matrix of contacts. For $l_{ij} \in \Omega_t$ we have that $l_{ij} \in \Gamma_{i_t}$ if their organizational practice α_{j_t} is bigger than that of the individual i and the cognitive distance between i and j ($\Delta\alpha_t$) tend to zero. In other words, information is shared with those that have a bigger organizational practice to their own, but not too high.

Be then Γ_{i_t} the group of individuals with those that the agent i shares information in the instant t, we have:

$$\Gamma_{i_t} = \{l_{ij} | \alpha_{j_t} > \alpha_{i_t}, \Delta\alpha_t \rightarrow 0, \Delta\alpha_t = \alpha_{j_t} - \alpha_{i_t} \text{ y } 0 < \alpha_{j_t} < 1 \text{ con } j = 1, 2, \dots, N\}$$

Hence $\Gamma_{x_t} = \bigcup_i \Gamma_{i_t}$ and the number of individuals that share information in the firm corresponds to the cardinal of this group ($|\Gamma_{x_t}|$).

It is this way, $A_x = \frac{|\Gamma_{x_t}| - |\Gamma_{x_{t-1}}|}{N}$ represents the positive growth rate of collaboration in the firm when $|\Gamma_{x_t}| > |\Gamma_{x_{t-1}}|$ and negative when $|\Gamma_{x_t}| < |\Gamma_{x_{t-1}}|$.

If $\ell_{ij} \notin \Gamma_{i_t}$ then $\ell_{ij} \notin \Gamma_{x_t}$ in this case, novelty and opportunism emerge since the cognitive distance is high (Nooteboom 2000). Hence novelty will appear as new information (I) and opportunism as filtration of information (F).

If $I - F < 0$ then filtered information is bigger than received information; that is, that the accumulation of the knowledge of agents engaged in collaboration, generated by the interaction with the opportunism, is negatively affected by the group of agents engaged in opportunism at the time; that will have an effect on A_{x_t} because the probability that an agent engaged in opportunism to filter information will be high. In this case $\sum_{\ell_{ij} \in \Gamma_{x_t}} \lambda_j < \sum_{\ell_{ij} \notin \Gamma_{x_t}} \lambda_j$.

With this we have finished analyzing the terms related to the equation (1).

Now, as for the equation (2), we define the neighborhood of agents engaged in opportunism/novelty as the complement of Γ_{x_t} , that is $\Gamma_{x_t}^c$. With the cardinal of this set we define the rate of the opportunism'/novelty's growth like $A_y = \frac{|\Gamma_{x_t}^c| - |\Gamma_{x_{t-1}}^c|}{N}$.

As for the case of the collaboration, in presence of novelty and filtration of information, we have that when $I - F > 0$ the information acquired by the agent engaged in

collaboration is bigger than the one filtered by the agents engaged in opportunism at the time. This will impact the A_{yx} , because the probability that an agent engaged in collaboration allows an agent engaged in opportunism obtain information at her detriment, will be small. This will make the working hours of agents engaged in opportunism decrease.

So if $I - F > 0$ then $\sum_{i_{ij} \in r_{xt}} \lambda_i > \sum_{i_{ij} \in r_{xt}} \lambda_j$; this indicates that the knowledge accumulated by the agents engaged in opportunism is smaller than that of the agents engaged in collaboration at the time.

By cognitive dimension of the individuals, we can analyze the behavior of the difference among the acquired information and the filtered one. In an instant t , each agent has a “background” knowledge (μ_{i_t}) ; also, as consequence of interacting with others, the agent acquires new knowledge (θ_{i_t}) . The agent's i cognitive dimension of in the instant t will be $\lambda_{i_t} = \mu_{i_t} + \theta_{i_t}$.

The weight of the “background” knowledge is given by the experience and the education acquired by the individual until instant t and the weight acquired knowledge to the interaction with other agents, it can be determined with that expression that shows under what conditions an individual adopts practical organizational of other agents.

According to the Lazaric's and Raybaut's (2005) model, the practice is adopted from those agents that have a higher organizational practice and are more productive. So the neighborhood that contains these agents will be V_{i_t} :

$$V_{i_t} = \{l_{ij} | \alpha_j = \max(\alpha_{j_t}, \alpha_{i_t}, \alpha_i^*), \Delta\alpha_t > 0, \text{ con } j = 1, 2, \dots, N\}$$

$$\text{So, } \theta_{i_t} = \frac{|V_{i_t}|}{N}.$$

In this way, we have established our model opportunism-collaboration and analyzed its different terms.

Terminology

t: time measured in hours.

x : level of collaboration in the instant t (time).

y : level of opportunism in the instant t (time).

A_x : rate of growth of the collaboration in the time t.

A_y : rate of growth of the opportunism in the time t.

A_{xy} : probability that the opportunism obtain the collaboration' information.

A_{yx} : probability that the collaboration allow the opportunism to obtain information.

Ω_t : matrix of an individual's contacts z in the time t.

I: new information o novelty.

F: filtered information.

$i = 1, 2, 3, \dots, N$

N : individuals' number in the company.

$\alpha_{i_t}^*$: the organizational practice of the agent i adapted to the new knowledge acquired in the time t .

σ : percentage of contacts in the firm $\sigma = \frac{1}{N} \sum_{i=1}^N \xi_i$ and, $\xi_i = \frac{L_i}{N-1}$, $L_i = \sum_{j=1}^N l_{ij}$

l_{ij} is the contact between the agent i with j , component ij of the matrix Ω_t

k_{i_t} : the knowledge of the agent i in the time t .

μ_{i_t} : weight of the knowledge of the agent i in the time t .

$$\mu_{i_t} = \frac{k_{i_t}}{\sum_{i=1}^N k_{i_t}}$$

θ_{i_t} : the knowledge acquired by the agent i , because of the interaction with other individuals in the instant t .

λ_{i_t} : the cognitive dimension of the agent i in the time t .

$$\lambda_{i_t} = \mu_{i_t} + \xi_{i_t}$$

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